

Analysis and Comparison of the Trends in Burden of Acne Vulgaris in China and Worldwide from 1990 to 2021

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Background: Acne vulgaris is a common chronic inflammatory skin disease with substantial psychosocial consequences, primarily affecting adolescents. Despite its global prevalence and significant impact on quality of life, long-term and standardized comparisons of acne burden between China and the rest of the world remain limited. This study aimed to analyze and compare trends in the burden of acne vulgaris in China and worldwide from 1990 to 2021, with a particular focus on sex- and age-specific differences.

Methods: Data were extracted from the Global Burden of Disease 2021 study. Incidence, prevalence, and disability-adjusted life years were assessed. Age-standardized rates were calculated, and trends quantified using average annual percentage change and Joinpoint regression.

Results: Globally, acne burden increased, with age-standardized incidence rising from 1442.92 to 1645.24 per 100,000. In China, absolute cases declined, but standardized rates increased. Adolescents aged 10–19 years consistently showed the highest burden, with females more affected. China exhibited earlier and faster increases in standardized rates compared to global trends.

Conclusion: The acne burden has increased over the past three decades, especially among adolescents and females, highlighting the need for targeted prevention and management strategies.

Keywords: acne vulgaris, disease burden, global burden of disease, age-standardized rates, temporal trends, China

Introduction

Acne vulgaris is a chronic inflammatory disease of the pilosebaceous unit, predominantly affecting adolescents but frequently persisting or even first appearing into adulthood.^{1,2} Clinically, it is characterized by comedones, inflammatory papules, pustules, and occasionally deeper nodules or cysts that may result in scarring and pigmentary changes.^{1,3} Despite being non-life-threatening, acne significantly impairs quality of life, primarily due to its chronic nature, visibility, and associated psychological distress, such as anxiety, depression, and diminished self-esteem.^{4,5} Previous global health studies have consistently documented substantial psychosocial impacts, emphasizing the importance of acne vulgaris as a public health issue.⁶

The epidemiological burden of acne vulgaris varies significantly among different countries and regions, influenced by a complex interplay of genetic predisposition, hormonal regulation, dietary patterns, environmental factors, and the accessibility of healthcare services.⁷ In China, rapid urbanization, changing lifestyle and dietary patterns, and increasing psychological stress may have uniquely shaped the epidemiological landscape of this disease in recent decades.⁸ However, direct comparisons between national trends and global trajectories of acne vulgaris burden using standardized metrics remain scarce.

To address this gap, we utilized comprehensive data from the Global Burden of Disease (GBD) 2021 study to systematically analyze and compare the long-term trends in acne vulgaris burden in China and globally, covering the period from 1990 to 2021. We evaluated trends in incidence, prevalence, and disability-adjusted life years (DALYs), employing age-standardized rates to facilitate international comparisons. Furthermore, we conducted detailed sex- and age-stratified analyses to elucidate demographic disparities. By providing a robust comparative perspective, our study aims to enhance the understanding of acne vulgaris epidemiology and to inform public health strategies tailored to both the Chinese population and broader global contexts. In addition to updating estimates through GBD 2021, our analysis emphasizes quantified temporal trend assessment (joinpoint regression and average annual percentage change) and standardized China-global comparisons of age-standardized incidence rate (ASIR), age-standardized prevalence rate (ASPR), and age-standardized DALY rate (ASDR), with consistent sex- and age-stratified reporting.

Methods

Data Source

The data analyzed in this study were derived from the GBD Study 2021, coordinated by the Institute for Health Metrics and Evaluation (IHME). The GBD 2021 provides comprehensive estimates of incidence, prevalence, mortality, and DALYs for 371 diseases and injuries across 204 countries and territories from 1990 to 2021.⁹ Data on acne vulgaris were obtained via the Global Health Data Exchange online database (<https://vizhub.healthdata.org/gbd-results/>). It should be noted that GBD 2021 estimates are model-based outputs generated using standardized statistical modeling frameworks that synthesize available data sources, and therefore represent modeled estimates rather than direct observations.

We extracted data for China and for the global population, including the annual number of cases and age-standardized rates (ASRs) for incidence, prevalence, and DALYs, across all age groups and both sexes. The ASRs were standardized using the GBD world standard population to eliminate confounding due to age structure differences. Data estimation in the GBD 2021 relies on the DisMod-MR 2.1 Bayesian meta-regression framework,¹⁰ which integrates evidence from multiple sources, including population-based surveys, published literature, administrative databases, and disease registries, and ensures internal consistency across disease parameters. Systematic corrections are applied to account for underreporting, misclassification, and missing values. For the age-specific analyses, data were extracted in five-year intervals (from 5–9 years up to 95+ years), allowing for the examination of disease burden variation across the lifespan. Age groupings were defined according to the standard GBD age categories to maintain consistency and comparability across locations and years; these strata also facilitate clinically interpretable sex- and age-specific comparisons of incidence, prevalence, and DALYs.

Statistical Analysis

We conducted descriptive analyses of the temporal trends in acne vulgaris burden from 1990 to 2021. Indicators analyzed included the ASIR, ASPR, and ASDR. All analyses were stratified by sex, age group, and geographic location (China vs global). To evaluate the overall trends during the study period, we computed the Average Annual Percentage Change (AAPC) and 95% confidence intervals (CIs) for each ASR. The AAPC was derived from a log-linear regression model fitted to the annual ASR data using the Joinpoint Regression Program (version 4.9.1.0, National Cancer Institute).¹¹ This model allows for detecting changes in trend segments over time and estimating a weighted average of the annual percent change over the entire period, even when multiple joinpoints are identified. The formula used for estimating AAPC is: $AAPC = 100 \times (e^{\beta} - 1)$.¹² A statistically significant increase or decrease in ASR was defined based on whether the 95% CI of AAPC excluded 0. An AAPC greater than 0 with a lower CI bound above 0 indicated an increasing trend, while an AAPC less than 0 with an upper CI bound below 0 indicated a decreasing trend. If the 95% CI included 0, the trend was considered stable. We further examined age-specific distributions of incidence, prevalence, and DALYs for the years 1990 and 2021 to assess shifts in disease burden across age groups and identify high-burden populations. Statistical analyses and data visualization were conducted using R software (version 4.4.1). A P-value of less than 0.05 was considered indicative of statistical significance.

Results

Trends in Incidence of Acne Vulgaris in China and Globally

From 1990 to 2021, both China and the world experienced a noticeable rise in the incidence of acne vulgaris. Globally, the number of new cases increased from 85.6 million in 1990 to 124.3 million in 2021. While in China, the incident case count remained relatively stable, decreasing marginally from 20.8 million to 19.9 million. China's ASIR rose from 1632.41 per 100,000 in 1990 to 1915.81 per 100,000 in 2021. The global ASIR also increased during this period, from 1442.92 to 1645.24 per 100,000. The average annual percentage change (AAPC) in ASIR was 0.524% (95% CI: 0.509 to 0.539) in China and 0.424% (95% CI: 0.407 to 0.441) globally (Table 1).

Trends in Prevalence of Acne Vulgaris in China and Globally

From 1990 to 2021, the number of prevalent cases of acne vulgaris increased significantly on a global scale, rising from approximately 166.6 million to 239.7 million, representing a 43.84% increase. In contrast, China experienced a decline in absolute case numbers, decreasing from 42.6 million to 39.5 million, a reduction of 7.42%. Despite this numerical decline in China, ASPR increased over the same period. The ASPR in China rose from 3166.57 per 100,000 in 1990 to 3742.20 per 100,000 in 2021. The AAPC was 0.553% (95% CI: 0.542 to ASPR0.564). Globally, the ASPR increased from 2800.55 to 3142.47 per 100,000, with an AAPC of 0.375% (95% CI: 0.364 to 0.386).

Trends in DALYs of Acne Vulgaris in China and Globally

Between 1990 and 2021, the total DALYs caused by acne vulgaris increased substantially worldwide, rising from approximately 3.56 million (95% CI: 2.23 to 5.59 million) in 1990 to 5.13 million (95% CI: 3.23 to 8.07 million) in 2021, marking a 43.8% increase. Conversely, in China, the total DALYs slightly declined from 917,928 (95% CI: 572,154 to 1,443,296) to 849,659 (95% CI: 530,715 to 1,331,378), representing a 7.4% decrease. Despite the decrease in total DALYs in China, the ASDR rose from 68.20 per 100,000 in 1990 to 80.74 per 100,000 in 2021, with an average AAPC of 0.552% (95% CI: 0.529 to 0.575). Globally, the ASDR increased from 59.87 to 67.23 per 100,000, with an AAPC of 0.376% (95% CI: 0.354 to 0.398).

Table 1 The Incidence, Prevalence, and DALYs Cases for Acne Vulgaris Across All Age Groups, as Well as the Age-Standardized Rates, Were Analyzed for China and Globally in the Years 1990 and 2021. AAPC Were Also Calculated

Location	Measure	1990		2021		1990–2021 AAPC
		All-Ages Cases (95% CI)	ASR (95% CI)	All-Ages Cases (95% CI)	ASR (95% CI)	
China	Incidence	20,793,408.85 (18,565,209.56 to 23,388,070.29)	1632.41 (1445.72 to 1843.79)	19,912,141.33 (17,768,188.01 to 22,495,197.98)	1915.81 (1694.74 to 2182.02)	0.524 (0.509 to 0.539)
	Prevalence	42,619,852.51 (38,256,909.01 to 47,529,057.93)	3166.57 (2844.55 to 3522.45)	39,458,444.56 (36,080,237.84 to 43,300,753.98)	3742.20 (3380.31 to 4152.45)	0.546 (0.524 to 0.568)
	DALYs	917,927.90 (572,154.21 to 1,443,296.37)	68.20 (42.46 to 107.20)	849,659.14 (530,715.48 to 1,331,378.17)	80.74 (50.48 to 126.62)	0.552 (0.529 to 0.575)
Global	Incidence	85,586,350.63 (76,228,677.06 to 97,067,128.18)	1442.92 (1286.88 to 1634.52)	124,266,429.81 (110,490,152.00 to 141,551,957.34)	1645.24 (1459.69 to 1878.22)	0.424 (0.407 to 0.441)
	Prevalence	166,623,285.56 (151,390,613.90 to 186,063,111.51)	2800.55 (2555.33 to 3115.10)	239,665,793.26 (218,962,319.06 to 266,545,356.99)	3142.47 (2866.96 to 3500.62)	0.372 (0.354 to 0.39)
	DALYs	3,563,944.99 (2,229,878.70 to 5,590,742.33)	59.87 (37.47 to 93.95)	5,125,473.49 (3,225,014.36 to 8,069,826.91)	67.23 (42.30 to 105.84)	0.376 (0.354 to 0.398)

Abbreviations: AAPC, average annual percentage change; DALYs, disability-adjusted life years; CI, confidence interval.

Joinpoint Regression Analysis of the Burden of Acne Vulgaris in China and Globally

Joinpoint regression analysis revealed distinct temporal patterns in the burden of acne vulgaris between 1990 and 2021 in China and at the global level (Figure 1). For the ASIR, the AAPC in China was 0.52%, slightly higher than the global AAPC of 0.42%. In China, the most notable increase occurred from 1990 to 1999 (annual percent change [APC] = 0.59%), followed by sustained rises in 1999–2005 (APC = 0.44%), 2005–2015 (APC = 0.59%), and 2015–2021 (APC = 0.39%). At the global level, five trend segments were identified, with APCs ranging from 0.25% to 0.56%, peaking between 2006 and 2014. In terms of the ASPR, China exhibited an AAPC of 0.55%, which exceeded the global AAPC of 0.370%. The steepest rise in prevalence in China occurred from 2006 to 2009 (APC = 0.66%), while global ASPR showed a more moderate increase, with the highest APC of 0.53% between 2010 and 2014. The ASDR also demonstrated a steeper upward trajectory in China (AAPC = 0.55%) compared to the global estimate (AAPC = 0.38%). The most significant increase in ASDR in China was observed between 2006 and 2009 (APC = 0.69%), whereas the global ASDR peaked between 2011 and 2014 (APC = 0.56%). Despite temporal fluctuations, both China and the world experienced sustained increases in ASDR over the study period.

Gender Disparities in the Burden of Acne Vulgaris Across Age Groups in China and Globally

Figure 2 and SFigure 1 illustrate the number of incident cases, prevalent cases, and DALYs for acne vulgaris in different age and sex groups in China and globally for the years 1990 and 2021. Overall, adolescents aged 10–19 years bore the

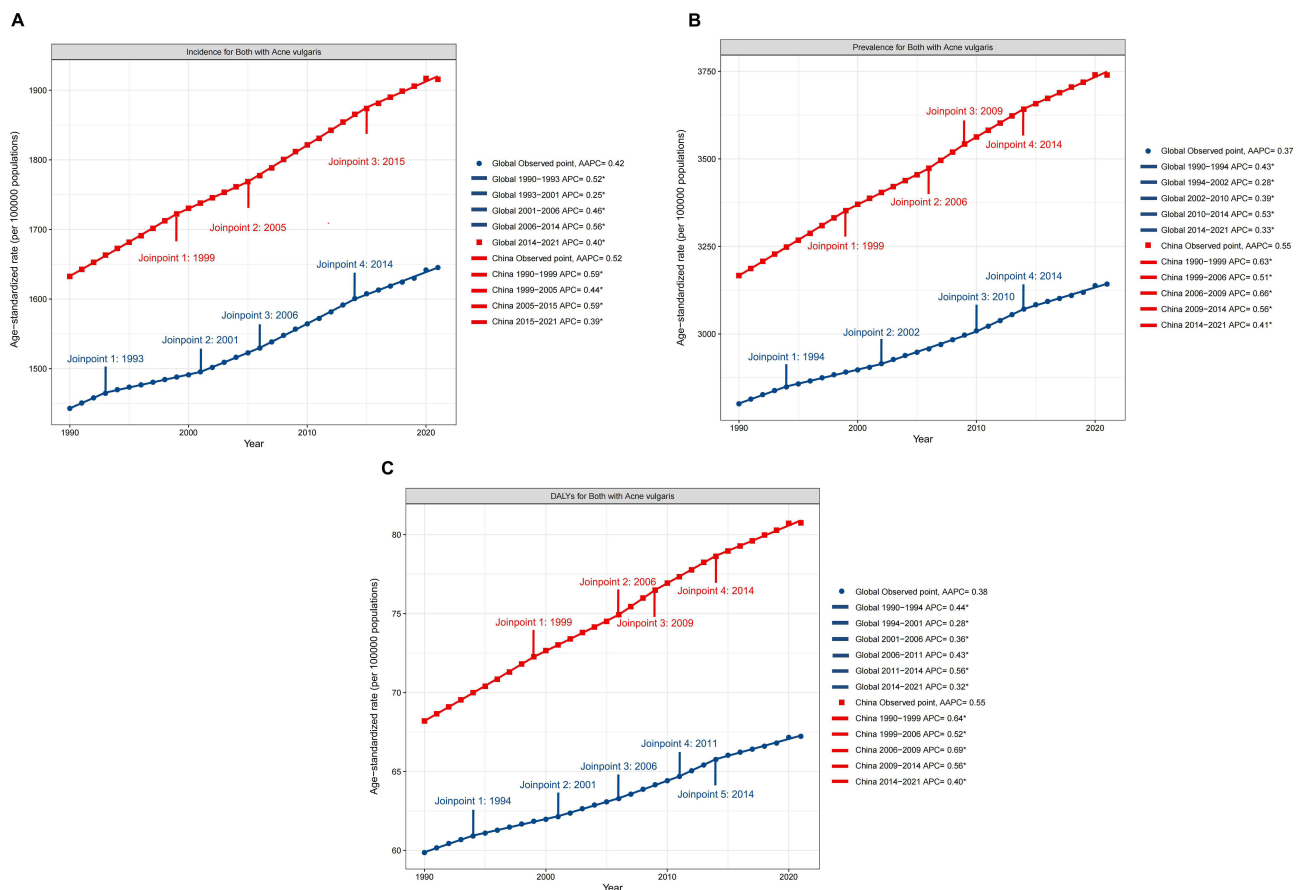


Figure 1 Trends in the annual percentage change (APC) of the age-standardized incidence rate (ASIR), prevalence rate (ASPR), and disability-adjusted life years (DALYs) rate (ASDR) for acne vulgaris in China and worldwide from 1990 to 2021. **(A)** ASIR; **(B)** ASPR; **(C)** ASDR. *Denotes statistically significant APC ($P < 0.05$). The red curve represents China, and the blue curve represents global estimates.

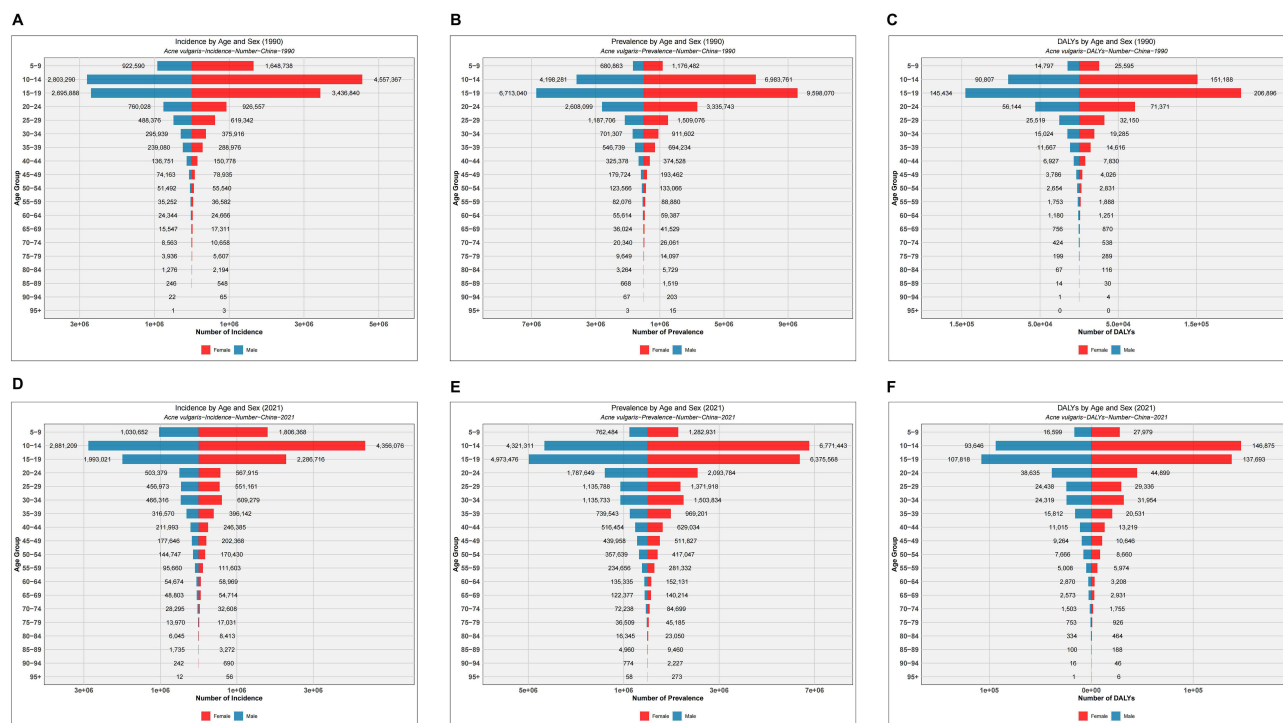


Figure 2 Comparison of the incidence, prevalence, and disability-adjusted life years (DALYs) for acne vulgaris by sex and age group in China in 1990 and 2021. (A) Incidence in 1990; (B) Prevalence in 1990; (C) DALYs in 1990; (D) Incidence in 2021; (E) Prevalence in 2021; (F) DALYs in 2021.

highest burden of acne vulgaris, both in China and worldwide, with females consistently exhibiting greater disease burden than males.

In China, for individuals aged 10–14 years, the number of incident cases in males slightly increased from 2,803,290 in 1990 to 2,881,209 in 2021, whereas females experienced a decline from 4,557,367 to 4,356,076. Similarly, the number of prevalent cases in this group rose in males from 4,198,281 to 4,321,311, but decreased in females from 6,983,761 to 6,771,443. The DALYs in females decreased slightly from 151,188 in 1990 to 146,875 in 2021, while in males, they increased from 90,807 to 93,646 (Figure 2).

At the global level, adolescents aged 10–19 years consistently experienced the highest burden of acne vulgaris from 1990 to 2021. Among individuals aged 10–14 years, the number of incident cases increased markedly in females from 20,868,649 in 1990 to 31,351,891 in 2021, and in males from 17,049,871 to 26,103,005. For those aged 15–19 years, the number of prevalent cases in males rose from 30,267,088 to 42,764,750, while in females it increased from 35,687,037 to 48,164,481. Regarding DALYs, females aged 15–19 experienced a rise from 762,689 in 1990 to 1,029,075 in 2021, and males showed a similar upward trend from 651,413 to 921,335 (SFigure 1).

From 1990 to 2021, both China and the world experienced a notable increase in the ASIR, ASPR, and ASDR of acne vulgaris in both sexes, with consistently higher values observed among females. In China, the ASIR among females rose from 1999 to 2365 per 100,000, while the ASPR increased from 3868 to 4603, and the ASDR grew from 83 to 99 per 100,000. Among males, the ASIR increased from 1289 to 1521, the ASPR from 2307 to 2770, and the ASDR from 54 to 65 (Figure 3). Globally, a similar pattern was observed. The ASIR in females increased from 1666 to 1867 per 100,000, and in males from 1227 to 1434. The ASPR rose from 3256 to 3573 in females and from 2359 to 2730 in males. The ASDR also showed an upward trend, increasing from 69 to 76 per 100,000 in females and from 51 to 59 in males (SFigure 2).

These findings highlight a persistent gender disparity, with females consistently exhibiting a higher burden of acne vulgaris across both China and the world. Although both sexes experienced increased rates, the absolute burden remained disproportionately higher in females throughout the study period.

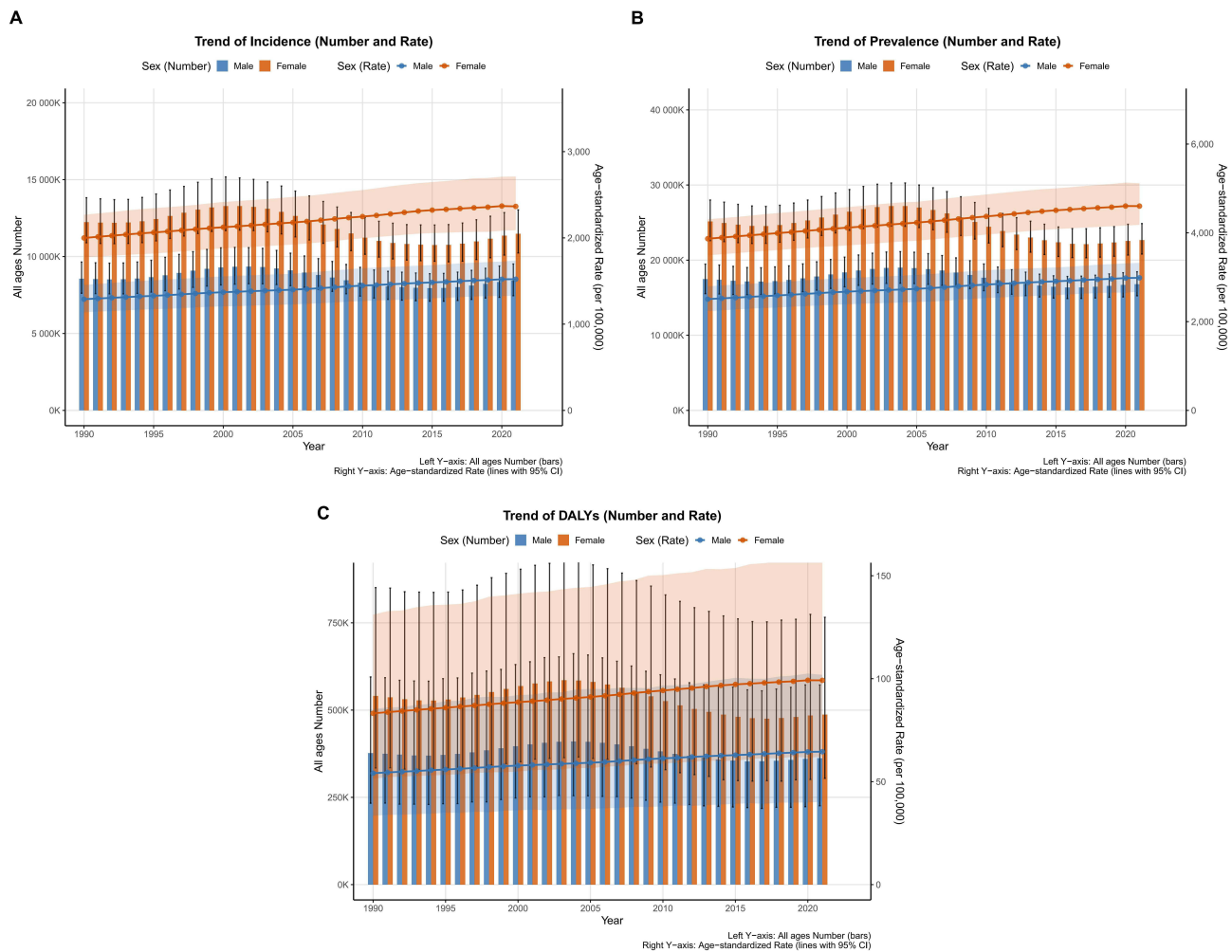


Figure 3 Comparison of all-age cases and age-standardized rates for the incidence, prevalence, and disability-adjusted life years (DALYs) of acne vulgaris in males and females in China from 1990 to 2021. (A) Number of incidence and age-standardized incidence rate (ASIR); (B) Number of prevalence and age-standardized prevalence rate (ASPR); (C) Number of DALYs and age-standardized DALYs rate (ASDR). Bar charts present the number of cases; lines represent the age-standardized rates.

Burden of Acne Vulgaris in Different Age Groups in China and Globally in 1990 and 2021

In China, the age group with the highest number of incident cases remained concentrated in adolescents. The 10–19 years age group exhibited the highest incidence in both 1990 and 2021, although a noticeable increase was also observed among young adults aged 20–24 years during the same period (Figure 4). Similar patterns were observed for prevalence and DALYs, with both metrics peaking in the 10–19 years age group in both years. The ASIR, ASPR, and DALYs also reached their highest levels in the 10–19 years age group, reflecting the substantial burden of acne vulgaris in early adolescence. Globally, similar age-specific trends were observed (SFigure 3). The burden of acne vulgaris remained predominantly concentrated among adolescents, with incidence, prevalence, and DALYs peaking in the 10–19 years age group across both 1990 and 2021. Overall, these findings highlight that the burden of acne vulgaris remains primarily concentrated among adolescents, both globally and in China.

Discussion

This comprehensive analysis based on data from the GBD 2021 study provides updated insights into long-term trends in the burden of acne vulgaris in China and globally. Consistent with prior epidemiological findings, adolescents aged 10–19 years remain the group most significantly affected by acne vulgaris worldwide and within China.^{8,13} Our study

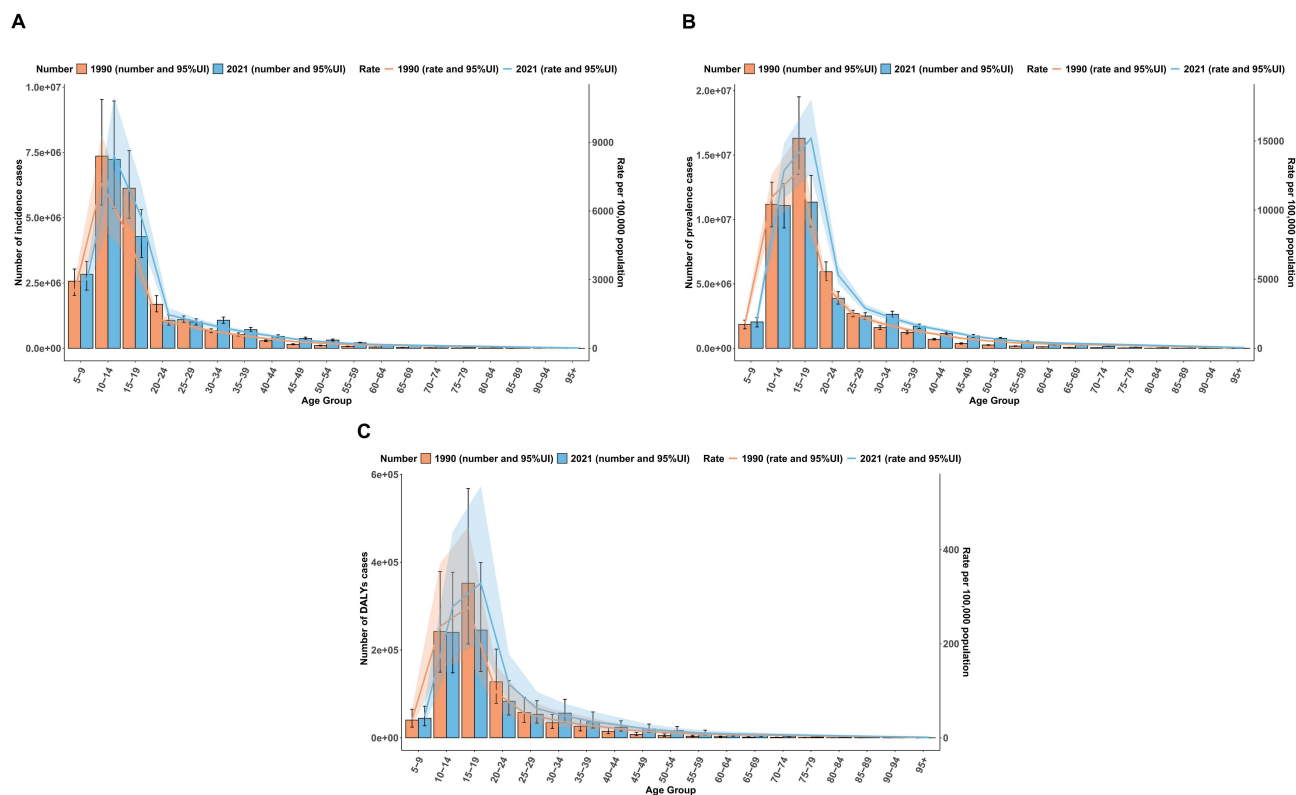


Figure 4 Comparison of the number of incident cases, prevalent cases, and disability-adjusted life years (DALYs), along with corresponding crude rates of acne vulgaris, across different age groups in China for the years 1990 and 2021. **(A)** Number of incident cases and crude incidence rates; **(B)** Number of prevalent cases and crude prevalence rates; **(C)** Number of DALYs and crude DALY rates. Bar charts represent the number of cases, and line graphs represent the crude rates.

further highlights demographic disparities and regional variations in the trajectory of acne burden over the past three decades, suggesting that acne is not only a dermatological issue but also a marker of broader public health transitions.^{14–16}

Globally, the absolute numbers of incident cases, prevalent cases, and DALYs attributed to acne vulgaris increased markedly from 1990 to 2021. This pattern is consistent with previous reports describing an increasing global burden of skin diseases, which may be related to demographic changes such as population growth and broader societal transitions.⁴ Notably, we observed a higher burden of acne among females, consistent with prior studies.^{8,17} In contrast, China demonstrated a distinct epidemiological pattern. Although ASIR, ASPR, and ASDR increased steadily, the absolute numbers of incident cases, prevalent cases, and DALYs showed a decreasing trend. This divergence is consistent with demographic changes in China, including population aging and declining fertility rates, which can influence the total number of affected individuals over time.

The simultaneous decline in absolute counts and rise in age-standardized rates indicates that, after accounting for population age structure, the burden of acne vulgaris increased in China over time. Age-specific analyses further showed that the burden remained predominantly concentrated among adolescents both globally and in China, with the 10–19 years age group consistently exhibiting the highest incidence, prevalence, and DALYs. This pattern is consistent with the well-established contribution of pubertal hormonal and physiological changes to acne pathogenesis, and it also underscores adolescence as a critical window for prevention and timely management.^{18,19}

The Joinpoint regression analysis provided additional insight into temporal patterns in acne burden. Overall, both China and the global population experienced significant upward trends in ASIR, ASPR, and ASDRs from 1990 to 2021, although the magnitude and timing of increases differed between China and the global level. In China, Joinpoint analysis suggested a steeper upward trend in age-standardized rates than the global average. The AAPCs in ASIR, ASPR, and ASDR in China consistently exceeded those observed globally, indicating relatively faster growth in the standardized

burden after adjusting for population structure. More pronounced increases were observed after 2005. Because GBD estimates are model-based and do not directly measure individual-level exposures such as lifestyle, diet, or environmental factors, the following contextual explanations should be interpreted as hypothesis-generating rather than causal inferences. The timing of these changes coincides with rapid socio-economic transitions in China, including accelerated urbanization and changes in population living conditions.²⁰ Prior literature has proposed that such transitions could potentially influence acne through pathways involving androgen-related signaling, insulin-like growth factor stimulation, mTORC1 activation, sebum production, and cutaneous inflammation.^{21–26} In contrast, global standardized rates also demonstrated upward trajectories, but with more gradual slopes and later inflection points, suggesting a more moderate and temporally delayed escalation worldwide. Taken together, these results highlight China's distinct temporal trajectory relative to the global level while avoiding direct attribution to unmeasured drivers.

From a public health perspective, our findings support the continued need for targeted acne prevention and control efforts among adolescents, particularly females, both globally and in China. In China, additional attention may also be warranted for young adults given the increasing age-standardized burden observed in this group. Our results further emphasize the importance of distinguishing between absolute burden and age-standardized rates when evaluating disease trends, particularly in settings undergoing demographic transitions. In summary, Joinpoint regression highlights China's distinctive epidemiological trajectory, characterized by a faster and earlier acceleration in age-standardized acne burden. These findings support the need for age-specific and evidence-informed strategies in China, especially among adolescents and young adults, to address the public health impact associated with this highly prevalent condition.

Several limitations should be acknowledged. First, GBD 2021 estimates are model based and rely on the availability, coverage, and quality of underlying data sources, which vary across locations and over time and may introduce uncertainty into estimated levels and trends. In addition, for acne vulgaris, part of the input evidence base may include self reported or survey based information in some settings. Because acne is often self managed and does not always lead to clinical contact, differences in outpatient care access, health seeking behavior, diagnostic practices, and reporting completeness may further affect ascertainment. Therefore, cross region comparisons should be interpreted with caution. Second, important clinical dimensions such as acne severity and treatment history were not captured in this aggregate analysis, limiting inferences about individual level disease impact. Finally, the absence of subnational data restricts insights into within country heterogeneity and may obscure local disparities relevant to public health planning.

Our study also suggests several directions for future research. Integrating hospital registries, community-based surveys, and longitudinal clinical cohorts could improve data precision and provide more granular information on disease severity, phenotypic subtypes, and treatment trajectories. Subnational analyses in China are particularly warranted to characterize urban-rural differences and potential region-specific correlates that are not visible in national-level estimates. In addition, prospective cohort studies that jointly assess environmental exposures, dietary patterns, hormonal and psychosocial factors, together with microbiome and metabolome profiling, will be important to clarify potential causal pathways and identify modifiable determinants of acne risk. Real-world evaluations of preventive and therapeutic strategies, including dietary interventions, stress management programs, reduction of relevant environmental exposures, and timely treatment escalation, are warranted to assess whether these approaches can reduce clinical burden and DALYs.^{27,28}

In conclusion, acne vulgaris remains an important global public health concern, characterized by persistent age- and sex-related disparities and distinct regional trajectories. The increasing age-standardized burden among Chinese adolescents and young adults highlights the need for age-specific and evidence-based strategies. Future work incorporating subnational estimates and individual-level clinical data will be essential to refine prevention frameworks and therapeutic approaches, thereby advancing precision public health and mitigating the long-term impact of this highly prevalent but often underrecognized skin disease.

Data Sharing Statement

The datasets generated and/or analyzed during the current study are publicly available in the GBD database repository at: <https://vizhub.healthdata.org/gbd-results/>.

Ethics Statement

This study was exempt for approval based on item 1 and 2 of Article 32 of the Measures for Ethical Review of Life Science and Medical Research Involving Human Subjects dated February 18, 2023, China. The Ethics Committee of the General Hospital of Northern Theater Command determined that this study was exempt from ethics review.

Disclosure

The authors report no conflicts of interest in this work.

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